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THE KLONDIKE GOLD DISTRICT, IN THE YUKON VALLEY, CANADA.

A PAPER READ BEFORE THE ABOVE ASSOCIATION

BY

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By ROBERT BELL, I.S.O., M.D., D.Sc., LL.D., F.R.S., Chief Geologist and late Director of the Geological Survey of Canada.

Gold has been found in nearly every part of the Yukon Valley, but in the following paper I shall confine my remarks to the Klondike district, which has been surveyed and studied by officers of the Geological Survey of Canada and has been inspected by myself, so that I have the advantage of having seen what I will attempt to describe.

GEOGRAPHICAL POSITION.

The district lies in the far off north-western part of Canada, close to the east side and near the central part of the straight line along the 141st meridian which divides the extremity of the Dominion from Alaska. The intersection of latitude 64 deg. north, and longitude 139 deg. west, is on Hunker Creek, within the district.

CLIMATE AND CONDITIONS.

Being slightly north of the Arctic circle, the winters are severe, but the long days of summer are quite hot. The mild air from the Pacific Ocean has an important effect, and the climate is healthy for a white population. The whole region is covered with a northern forest of white and black spruce, aspen, balsam-poplar, and white birch, all of large enough size for use in building, mining, railway construction, &c. Hay and all the garden vegetables of the north temperate zone grow in perfection, and wheat almost ripens. I mention these things because an exaggerated idea of the climate has gone forth. The district is connected with the other world by a fleet of good steamers plying up the Yukon to the town of White Horse, 300 miles southward in a straight line, or 350 by the river, and the White Pass Railway, 90 miles long, from thence to Skagway, at the head of Lynn Canal, an inlet of the Pacific Ocean. There is also a telegraph line which forms a part of the continental system. So that the conditions of life are not too hard, and many men with their families have remained here continuously in comfort long enough to acquire wealth. When they return to live in their old homes in the United States and Canada, their places are taken by others. In the town of Dawson, at the north-west corner of the district, there is a strong detachment of the Royal North-west Mounted Police, living in permanent barracks, and, although the Klondike district is 5,060 miles from Halifax by the travelled route, law and order are as perfectly maintained throughout the whole region as in any part of England.

GEOLOGY.

The geology of that part of the Yukon region which includes the Klondike district is rather complicated. The rocks comprise representatives of various chronological divisions of the geological scale from the oldest to the newest, and also of every kind of physical action to which rocks of all kinds may have been subjected. Those within the Klondike district itself are of both igneous and sedimentary character, but most of them have undergone such changes in the course of their histories as to render it difficult to discover their original condition. The age of the bulk of the gold-bearing portion appears to the writer to correspond with the Huronian series or system of the more easterly parts of the Dominion. The Laurentian system may also be present.

A few words as to the meaning of these terms may be useful in this connection: We regard the Laurentian as the oldest rocks known —the foundation of the rocky crust of the earth. A lower and an upper division may be recognised in various parts of their distribution, which is very wide, comprising most of the north-eastern portion of North America, including Greenland. The rocks of the lower division are composed of only a few of the commonest minerals, quartz, and orthoclase being the principal ones, together with a smaller proportion of hornblende and a little biotite or phlogopite. Scattered small crystals of magnetite may be occasionally detected.

In this respect the Lower Laurentian contrasts with the Upper, in which there is a great variety of minerals, including ores of numerous metals, which, however, do not often occur in economic quantities, with the exception of iron, lead, and rarely copper. Structurally the Lower Laurentian may be described as consisting of heavy granitic gneiss or slightly laminated granite, which may be imperfectly banded owing to alternating belts of different shades of gray, pink, and light red. Although the average of the local strikes of these belts may show that a certain general direction prevails in a given area, the course of the lamination is generally quite local or ill-defined, with frequent changes, or it may be contorted. Again, by means of the alteration of shades, the bands may sometimes be found to form irregular parallel curves or zigzags, and sometimes they follow imperfect concentric ellipses of low or high eccentricity.

Upper Laurentian.

The Upper or Newer division of the Laurentian system is made up principally of a variety of well-foliated gneisses, arranged in distinct bands, also beds of crystalline limestones and dolomites, some of which are of great thickness, together with anorthosites, norites, pyroxenites, granites, massive and schistose greenstones, &c. Minerals of many kinds are found in the series. Over 150 different species have been collected in the townships opposite to the city of Ottawa. Among the economic minerals which these rocks have so far produced in commercial quantities are ores of iron, lead, and in a few cases of copper; also apatite, mica, fibrous serpentine, barite, celestite, marble, and a variety of semi-precious stones. There is little doubt that some of the gneisses represent altered sediments. The parallelism of the members of the series and the structural arrangement or geographical distribution of their outcrops resemble those of altered and disturbed sedimentary rocks of other formations. In some localities the arrangement is tolerably regular, but in others it is considerably disturbed or corrugated.

The total area of the Upper division is less than that of the Lower, but the boundaries between them are only imperfectly known.

Huronian and Keewatin.

In the eastern half of the Dominion, or rather that greater part of it which lies eastward of the Mackenzie River, some large and many smaller areas are occupied by a great pyroclastic series, the different parts of which, until recent years, were provisionally grouped under the name Huronian. Before they could be satisfactorily divided, this name was understood to embrace all the rock-formations between the Upper Laurentian and the lowest Cambrian. As far as this series was concerned, while the Canadian geologists gave their attention mostly to the discovery and tracing out of the geographical distribution of the Huronian areas in our vast territories, a few of them in later years, as well as some of the United States geologists, devoted themselves to a closer study of restricted areas in the Lake Superior region. They found that the lower part of the series consisted of igneous rocks mingled almost everywhere with some local aqueous deposits. The name Keewatin (pronounced Keewaytin) was given to this division, while the name Huronian is retained for the upper and greater part of the system, which is made up principally of a variety of sedimentary rocks that are more or less altered in some districts. A part of the Laurentian series was supposed by some geologists to be represented in a few places in the Rocky Mountain region. One of these is near the Klondike district. If this supposition be correct, then the Keewatin and Huronian are probably there as well. The above short description of our oldest rocks is intended to prepare the way for some remarks on the position of the Klondike auriferous series, since the geological age of rich gold-bearing rocks is one of the most interesting points in connection with the whole matter.

Rocks of the Klondike Gold District.

The Klondike gold district lies in the angle between the east side of the Yukon and the south side of the Klondike River, and measures about 40 miles from north-west to south-east by about 25 miles at right angles to this direction. The gold-bearing series within this area embraces a variety of crystalline schists and other rocks, which are here mentioned in the approximate order of their abundance: Foliated quartz, porphyry, silicious sericite, quartz-mica schists, imperfect gneisses, sheared greenstones, chloritic, and graphitic schists, rhyolites, andesites, and diabase, the last-mentioned passing in places into serpentine. The schists of this group have been mostly derived from massive rocks by pressure and shearing, but some of them are altered sediments. Silicious limestone occurs in a few places associated with silicious and argillaceous schists. Epidotic and actinolitic schists occur in a few instances. Nearly all these rocks contain many small and some larger veins of white quartz, which in the aggregate make up a proportion of the whole mass worth noting. Small quantities of accessory minerals of various species have been found in this group of metamorphic rocks. More recent intrusions of massive rocks of several groups and ages, penetrating through the old schists and gray granite, like that which forms the great coast range, have been observed cutting schists of sedimentary origin. Throughout the district the strike of the bedding and that of the cleavage or schistosity generally coincide, and they have a prevailing north-west and south-east course, and dip at rather low angles to the south-west, but, on the large scale, these lines sweep round through the district in flattened parallel concentric curves belonging to three sets or centres.

HURONIAN AGE OF THE KLONDIKE ROCKS.

The following are some of the reasons for classifying the gold-bearing rocks of the Klondike with the Huronian system:—No crystalline rocks of later age than the Huronian are known to occur elsewhere in this part of the Dominion, and there is no reason to assume that the Klondike series is exceptional in this respect. In the Rocky Mountains and other chains formed by profound upheaval through an immense thickness of strata, the oldest rocks are found in the central portions. Considerable areas, for 200 miles along the Yukon Valley, have been provisionally coloured as Laurentian by the western geologists. In the great region between Hudson Bay and the St. Lawrence Valley the older Huronian rocks are often conformable to the Laurentian and pass gradually into them. The Huronian is the great metalliferous series of eastern Canada and the adjoining States generally, and it has already been found to be more or less auriferous in nearly all parts of its distribution; whereas gold has been found, and only in traces, in but a few instances in the Upper and not at all in the Lower Laurentian. The Klondike rocks are certainly very ancient; the series belongs to the Huronian type, and it is not more auriferous here than the rocks of this system are in some localities in the east.

GEOGRAPHICAL AND PHYSICAL CONDITIONS.

The Yukon River has a course of about 1,500 miles, from its source, a short distance inland from the Pacific Ocean at Lynn Canal, to its mouth in Norton Sound. The upper or Canadian portion runs north-west in a narrow valley through a mountainous country, but soon after it passes into Alaska, it is joined by a large branch from the east side called the Porcupine River; the valley broadens and the direction of the main stream changes suddenly from north-west to west-south-west, which is a continuation of the course of the Porcupine. Notwithstanding that the upper portion of the Yukon is closely flanked by mountains on both sides all along its course, it maintains an even grade throughout of about 3 ft. in the mile. In the season of low water it is only deep enough for flat-bottomed steamers, and flows at a nearly uniform rate of 3 or 4 miles an hour over a bottom composed of shingle, gravel, and sand. It is a clear-water stream, and has a width of about 200 yds. at White Horse and 400 at Dawson.

The Klondike gold district partakes of the mountainous character of the rest of the Yukon region. Its highest point, called The Dome, is a little north of the centre, and nearly all the ridges and valleys radiate from it. Its altitude is 4,250 ft. above the sea, or 3,050 above the Yukon River at the town of Dawson, which is 1,200 ft. over sea level. The district has been surveyed by the Geological Department, and the contour lines of the hills have been defined at 50 ft. intervals up to 2,000 ft.

The map representing this work shows in a striking manner how deeply the district has been dissected into a great number of ridges and hills by the small streams called "creeks," most of which, like the intervening ridges, radiate from The Dome. The average elevation of the ridges above the valley bottoms is about 1,500 ft. The crests of the ridges are unbroken, so that starting from The Dome and using the proper ridge for the purpose, one may reach any part of the district without crossing a valley. Although the flanks of the ridges are steep, their crests are rounded, with a little bare rock cropping out upon them in some places. Each deep valley starts from a cirque-like depression excavated in the side of a ridge, and it maintains for some distance down the character of a steep-sided ravine, but gradually expands, till, in its lower reaches, it becomes flat-bottomed, although not very wide, while the sides have become more or less distinctly terraced up to a height of 700 ft. above the valley bottoms.

At the beginning of the Pliocene epoch the whole Yukon region inside of Canadian territory, including the Klondike district, appears to have had an elevation above the sea of, say, 7,000 or 8,000 ft., and it seems to have maintained its stability for a very long period, during which the old crystalline rocks became deeply decayed and eroded, while the softened material was excavated on a large scale by almost innumerable brooks and some streams of greater size. The result was that the average altitude of the surface was reduced by denudation to the extent of perhaps 5,000 ft. Thus the smooth-sided mountains and valleys of the Klondike country were produced. After a great lapse of time, and while the slopes of the valley were deeply covered with the mixed débris from the disintegration of the softer and harder rocks, a gradual subsidence of the land took place, and was followed by a general elevation to an altitude exceeding that of the former surface by about 600 ft. The gradual subsidence of the land gave the incoming sea an opportunity to wash and modify the disintegrated rocky materials all the way up from the lowest to the highest levels, to round off the angles of the harder fragments, and to arrange them at many altitudes into beds which are sometimes of great thickness, even up to 100 and even 200 ft.

The White Channel gravels, described further on, belong to this period. The re-elevation to a height of about 600 ft. above the level, which had been so long maintained before the submergence permitted the retiring sea to cut the White Channel and other old gravels into terraces and beaches; and the increased height at which the land now stood enabled the streams in the Klondike district to deepen their valleys by about the same amount. The contrast between the steep sides and the angularity of the new or secondary valleys and the smooth and more gentle slopes of the old ones is easily recognised.

SOURCE OF THE PLACER GOLD.

An attempt will now be made to interpret the surface indications in regard to the later geological history of the Klondike district, and to try to account for the richness of its placers.

The investigations of Mr. R. G. McConnell and Mr. J. B. Tyrrell, which extended over several seasons, have shown that, during and since the Pliocene epoch, more events and changes have taken place in that territory than might have been supposed possible, and all of these involved time. The evidences of some of them, such as the invasion of the district by the Klondike River at a certain period, an event of great geological interest, could only have been detected by experienced geologists. The numerous phenomena which have occurred during the Pliocene and Post Pliocene epochs in the Yukon region indicate a more varied history, and also the lapse of a greater length of time than had heretofore been suspected.

The small veins of quartz which have been mentioned in describing the Klondike rocks are quite abundant in almost every part of the district. Nearly all of them are white, and they are usually hyaline, but many have developed a finely-granular structure. They are generally short and lenticular in form and vary from mere threads up to several inches in thickness and occasionally reach a foot or more. They often occur in groups, the individual veins of which are nearly parallel to one another and to the lamination, but veins are also found which form angles with both the dip and the strike of the schistosity. In the universal disintegration and waste of the Klondike rocks, the vein quartz, being the most resistant both as to decay and grinding down, has survived in fragmental form in much greater proportions than the country rocks that originally contained it, and it is now represented by heavy beds of shingle and gravel, which have received the name of the White Channel gravels, and these are found in great quantities at different levels in various parts of the district. Although these gravels look white in bulk, as compared with other gravels, yet about half of the individual stones are not quartz, but consist of rounded fragments of the harder and tougher kinds of the country rocks in the vicinity. The deeply disintegrated condition of the hillsides in the Klondike district would greatly facilitate the formation of gravel, and the quantities produced are enormous. On Trail and Lovett Hills alone, Mr. McConnell's assistants measured a total volume of 160,598,990 cubic yards of White Channel and Klondike gravels, the latter being the other high-level or older gravels associated with the former. The breaking up of the quartz veins and the liberation of the gold was facilitated by their freely jointed and slightly faulted character. The quartz cobble-stones and gravel sometimes contain specks and small nuggets of gold, and at the base of the White Channel deposits placer gold is always met with, and generally in commercial quantities.

Large nuggets are not common in the district. Most of the gold is, however, coarse and rough, but generally with the sharper angles and projections worn off. Much of it is as large as grains of barley and Indian corn, the remainder being mostly of the shape and size of somewhat flattened pellets of the smaller grades of shot. Only a small proportion is as fine as sand. In the unmodified rock-débris of the hillsides the newly-liberated gold is quite rough, and is sometimes crystalline. Here fragments of quartz from very small veins or threads are occasionally attached to crystals and rough nuggets of gold, showing that these have been derived, not from recognisable veins, but from small and thin sheets or lenses of quartz scattered through the country-rock. From all the foregoing evidence, the writer believes that a great deal of the gold of the Klondike, perhaps the major portion, has been derived from the thin, small, and inconspicuous lenses which follow the laminæ of the schistose rocks and sometimes cut across them. Grains and small nuggets of gold have been found elsewhere in the matrix of Huronian rocks, unconnected with any vein, stringer, or cavity, and this fact lends support to the opinion that much of the gold of the Klondike has had a similar origin.

Placers due to Great Concentration.

From the above short geological sketch, there appears to be no doubt that the extremely rich placers of the Klondike district are due to the concentration of the gold (during immense periods of time) from the enormous volume of only moderately auriferous rock which underwent decay and was removed by water, while the gold was allowed to remain behind on account of the absence of glaciation, which might have carried it away. Mr. J. B. Tyrrell has calculated that a depth of about 5,000 ft. of rock, which once existed above the present surface of the district, has been removed by decay and erosion. He has also shown that a very small value per cubic yard in this great mass of rock would account for all the gold which was left behind in the present surface deposits.

The placer gold found within the limits of each different class of original rock in the district is known to be sufficiently different in fineness and other characters to enable the assayers to recognise its source with certainty, and this is regarded as one of the proofs that the gold has merely sunk down, as it was liberated, within the original area of its matrix, while the lighter materials were being washed away, and that it has suffered but little horizontal movement.

The White Channel and Klondike Gravels.

The White Channel and the associated Klondike gravels are the oldest detrital deposits of the district, having been formed, as already described, by the first washing of the sea as the deeply decayed Mid-Tertiary land surface sank gradually beneath its waters, exposing every part in turn to its action. This is believed to have taken place in Pliocene times. Portions of these gravels having remained where they had been originally deposited, others, which have been subsequently formed at various periods, present a variety of relations to the older ones, which still remain the greatest in quantity. Sometimes the ancient gravels occur side by side with the newer ones in the valley bottoms, and both are profitably mined. On Hunker and Bonanza Creeks the volume of the white gravel increases in width and depth in proceeding down stream, showing a continuation of the conditions that accumulated this gravel, while the land sank and rose again. A considerable amount of gold has been concentrated under the gravel.

Great Interval Follows.

It has been already shown that since the close of the White Channel period, sufficient time has elapsed for the excavation of creek valleys to depths of 300 to 600 ft., through what was originally hard schist rock. This long period would permit of many geological changes taking place, some of which may have affected the arrangement of the auriferous deposits or caused a redistribution of the gold, and we must take this possibility into consideration in attempting to account for the present modes of occurrence of the precious metal. Therefore, the reason why some portions of the Klondike district are richer than others, and that certain peculiarities occur in the relative abundance of the gold in different parts, may not be entirely attributable to differences in the original productiveness of the rocks of the various localities, but may be due, in part, to this redistribution of the old auriferous gravels.

REMAINS OF MAMMALS AND TREES IN FROZEN GROUND.

The Klondike district has experienced two long periods of rock decay—one before and one after the submergence in Tertiary times, already referred to. Towards the close of the latter period the disintegrated stony *débris* and accompanying earth, silt, &c., became deeply frozen at a time which probably corresponds to the latest glacial epoch. This frozen mass is the most recent formation of the district, and contains the bones of several extinct mammals of the quaternary period, together with those of some living species and the wood of a few kinds of trees which still grow in the district. Among the animal remains are bones and numerous large tusks of the mammoth, bones and horns of a great extinct bison, and of the existing American bison, the moose, the reindeer or cariboo, a bear, and an extinct horse, of which Mr. J. B. Tyrrell found only a few bones. A well-made copper spear-head, which the writer saw at Dawson, was found at some depth in this deposit.

GREAT DEPTH OF FROZEN GROUND.

No animal or plant remains have been met with in any of the old gravels underlying this newest deposit.

This mass of unstratified material has resulted from the superficial decay of the rocks in the interval between the Pliocene and the latest glacial period. It is thickest on the lower levels and thinnest on the tops of the hills and ridges, as if it had gradually slidden down as it was formed, and accumulated in the valley bottoms. It is all permanently frozen to a great depth which, however, varies considerably according to situation. Borings at different places gave the following results:—Upon the ridge south of Eldorado Creek the bottom of the frozen mass was reached at 60 ft. from the surface, while in the valley of this creek unfrozen ground was first indicated by running water a little below 200 ft. On the plateau between the Klondike River and Bonanza Creek unfrozen ground was reached at 175 ft.

At the time of the writer's visit to Dawson, in 1905, a boring in progress near the centre of the town, and not far from the Klondike River, was down considerably more than 100 ft., and was still in frozen ground. In some of the excavations made by the miners in other parts of the district, portions of the frozen "ground" consisted of ice mixed with some earth. It is improbable that the ground would freeze to such great depths in the present climate of the Klondike. Where the living moss, or the deeper covering of muck is removed from the surface, the earth thaws in summer to a depth of 6 to 10 ft., but this becomes completely frozen again during the following winter, as it lies between the cold air and the underlying frozen earth, which has a temperature below 32° Fahr. Where the surface covering of vegetable matter is undisturbed the ground does not thaw all summer.

A record of the temperatures was being kept at the bore-hole above referred to in Dawson town, and it was found that the maximum cold had been reached at about 100 ft. from the surface. It was the opinion of the intelligent operator, with whom I conversed on the subject, that this was the general condition wherever the frozen ground had its full development. Since the usual depth of the frozen layer throughout the district appears to be about 200 ft., this would seem to show that the climate of the Klondike has so far improved since the last Glacial period, that the summer's thawing now penetrates to as great a depth as the winter's freezing. The great thickness of the frozen ground, and the low temperature of its mid-depth, indicate that the permanently frozen condition is a legacy from a colder period in the past, and that, if the climate continues to improve, it is probable a time will come when there will be a permanently unfrozen zone just below the superficial layer which would freeze every winter and thaw again in Spring. The concentration of the gold in a narrow streak on the bed-rock along the very bottom of the steep-sided valley of every creek indicates that this took place while the water was in a fluid state, and before the gravel had become frozen into a solid mass.

In order to get at these pay streaks, the miners require to excavate open cuts in the frozen gravels, or to tunnel under them. The courses of the existing creeks on top of the frozen gravels do not correspond with those of the pay streaks on the bed rock below, but run from side to side of the valley-bottom, frequently crossing and recrossing the underlying ancient channels along which the gold was deposited. Much gold is found under beds of water-washed sand and gravel, including the Klondike and White Channel gravels on the remains of old benches, which are now permanently frozen. It is evident, therefore, that the deposition of the workable gold of the Klondike in the ancient beds of creeks and under the gravel of old benches was due to water. There was no other means by which it could have been finally sorted out and concentrated in its present positions. It is equally evident that the deep freezing of the auriferous deposits, and of everything above them, took place since the gold was left where we now find it.

Glacial Movements in North America.

It was formerly supposed that the ice sheets which covered the northern half of the continent in the Glacial epoch, all moved from the northward to the southward; but it is now known that in some of the northern parts their motion was northward, or in other directions than towards the south. In the Yukon region, wherever glacial sheets existed at all, they moved towards the north; but the Klondike district was never scoured by moving sheets of ice. To this circumstance, and to the stability of the altitude of this part of the continent for long periods, have been due the accumulation of the gold of the Klondike in the lower levels, as its auriferous rocks decayed away and deposits of exceptional richness were formed by the action of water. Had the district suffered from moving land ice during the glacial period, which, as we have seen, was subsequent to the concentration of its gold, most of the precious metal might have been swept away and lost.

Discovery and First Workings.

Before the discovery of rich placers in the Klondike district, it had been known for some years that indications of gold could be found almost everywhere in the Yukon valley. In the summer of 1894 a party of prospectors discovered gold in workable quantity in the bed of Quartz Creek, a northern tributary of Indian River, in the southern part of the district. During the following winter, Robert Henderson found gold in Gold Bottom, a branch of Hunker Creek, which soon became one of the great producers. In 1896, a man named Carmack struck rich placers on Bonanza Creek, and the excitement following this led to the rapid development of the surrounding district.

Dimensions, Etc., of Claims.

The ordinary creek claims are 500 ft. in width, measured on a line following the general course of the stream, and from rim to rim at right angles to this line. "Rim rock" is the bed rock under the edge of the horizontal surface of the gravel of the valley-bottom, or where this gravel surface comes against the sloping rock of the side of the valley. Along most of the creeks, the breadth of the top of the gravel varies from about 200 to 1,000 ft.

Difficulties in Mining.

The difficulties in the working conditions are greatly increased, owing to the ground being everywhere deeply frozen by the long and severe winters, and the want of a good water supply for washing. During the first two or three years, the miners thawed the earth by the direct application of fires, for which the small northern trees of the district supplied the fuel. As soon as a few feet had been thawed in this way, the earth was shovelled out and a new fire kindled in the bottom of the pit. The fires burned better and thawed more earth than one might have expected under the circumstances. The process was repeated till the pay streak was struck. The dirt from it was placed in a separate pile and soon became refrozen. In spring, as it thawed out by the heat of the sun, it was washed by different methods, according to the quantity in stock.

This method gave place to a better one, by means of the steam thawer. This consists of an iron pipe, about 8 ft. in length, pierced all round the lower end by a number of small holes to allow the steam to escape, and plugged at the extremity with a sharp steel point. The upper end of the pipe is closed by a solid steel head, which receives the blows of the heavy hammers used to drive it deeply into the frozen gravel or earth. Hot steam is forced into the pipe near its upper extremity through an iron tube connected with a small boiler. The longer a thawer is allowed to remain forcing hot steam from one centre the wider will the softening extend in all directions, and, in this way, the frozen ground may be tunnelled along the pay streak to any distance, which was not possible by the wood fire method. The pay dirt is hoisted by a hand windlass, a horse, or by steam power, and dumped into elevated sluices, and water for washing is pumped from the creek or brought by a flume.

ACCESSIBILITY OF THE KLONDIKE.

When news of the discovery of a rich goldfield in the Klondike district reached the outside world, there was a rush thither of placer miners from Canada and other countries, and especially from the Pacific States of the American Union. In 1896 a continuous stream of eager men poured in from the port of Skagway, over the present route of the White Pass Railway to Whitehorse Rapids at the head of navigation on the Lewes River, the main upper branch of the Yukon. Now, the White Pass Railway from Skagway to Whitehorse, a distance of 90 miles, makes travelling easy between these points, and more than a dozen fine stern-wheeled steamers are running on the Lewes and the main Yukon, from Whitehorse to Dawson, without any interruption, a distance of about 350 miles by the stream. From Dawson the traveller may visit all parts of the Klondike district by driving over the smooth roads, with long easy grades, which have been constructed by the Canadian Government, at a cost of nearly two millions of dollars.

FLUCTUATIONS IN THE POPULATION OF DAWSON.

The town of Dawson, situated where the Klondike River falls into the Yukon, at the north-west corner of the Klondike district, sprang into existence as soon as the gold-mining began. In 1900 it had a settled and floating population of about 20,000, but in 1905 this had diminished to about 4,000, and the number is still smaller at the present time, having continued to diminish with the gold yield. A strong detachment of the Royal Canadian Mounted Police has always been stationed at Dawson, and law and order have been as well maintained in all parts of the Yukon region as in any other part of Canada.

YEARLY VALUES OF GOLD PRODUCED.

From the time of the discovery of gold in the Klondike district till 1896 the output was small, and no correct record of it was kept, but in that year placer mining began to be an important industry. A royalty of 10 per cent. on the gross yield was imposed by the Canadian Government in the following year, but, about 1904, it was reduced to 5 per cent. A means was thus established of keeping a record of the greater part of the production. The annual yield since 1896 is given by the statistical branch of the Geological Survey of Canada as follows:—

	$		$
1896	300,000	1903	12,500,000
1897	2,500,000	1904	10,500,000
1898	10,000,000	1905	7,876,000
1899	16,000,000	1906	5,600,000
1900	22,275,000	1907	3,150,000
1901	18,300,000	1908	3,150,000
1902	14,550,000		
		Total	126,701,000

This gold has been all safely cared for and sent out by the Dawson agency of the Canadian Bank of Commerce.

Other Minerals of the Klondike District.

The whole of the abovementioned gold was obtained by placer mining, for, although the precious metal is known to exist in a number of irregular short veins of quartz, and may sometimes be detected in stones of the White Channel gravel, no one has had sufficient confidence in these occurrences to test their value on a working scale.

No other metal is known to occur in economic quantities within the district. Small indications of copper pyrites have been noticed in the solid rocks. Smooth, well-rounded pebbles of oxide of tin (cassiterite), generally of small size, are occasionally found in the gold washings. On fresh fracture they all have a fibrous or finely columnar structure (wood tin). It has been asserted that grains and small nuggets of platinum have been found in this district, and also on a bar in the Yukon, near Big Salmon River, but these statements have not been confirmed. Globules of native mercury, and small indications of cinnabar are said to have been observed at one locality in the district, but there is no scientific evidence of such occurrences.

Cretaceous coal, of fairly good quality, occurs on and near the Yukon River, some miles below Dawson, and also at a few places in the banks of the river higher up.

Meteorites.

Two meteorites which had sunk through the earth and gravel down to bed rock were found within the Klondike. These would never have been discovered had it not been for the working and washing for gold in that district. One of them, which weighed only about 2 lb., was of a flattened pear shape. It had a smooth surface, and, on polishing and etching a section of it, the Widmanstätten figures were found to be of a wide pattern and strongly marked. The other meteorite weighed about 30 lb., and its surface is said to be not deeply pitted, but rusty and scaly from long burial in the gravel. The conditions connected with the finding of these two meteorites suggest the possibility that many of these bodies which fall upon the earth where the surface consists of soft, loose, or shifting material, may have sunk out of sight and are now resting on some firmer foundation or on bed rock.

Future Production.

The days of placer mining in the Klondike by individuals and on a comparatively small scale are over, but a large annual yield may be kept up for a long time by dredging and hydraulicking. Dredging was begun some years ago in the bed of the Klondike and other streams, and by starting work on artificial excavations elsewhere, which soon filled with water, allowing the dredge to advance and enlarge the pond in any direction. This process has been so successful that it will, no doubt, be carried on more extensively in the future, and increase the present rate of production.

Hitherto, hydraulicking has been practised only to a limited extent, as but a small supply of water could be obtained at sufficiently high levels. In order to get a large enough supply, engineers found that it would require to be brought from a long distance at great cost, on account of the hills and the deep valleys which intervene. However, by the enterprise of the Messrs. Guggenheim's Sons, the difficulties are being overcome, and before long hydraulicking, sluicing, and any other process which may require much water, will be in successful operation. It has been ascertained that the frozen condition of the gravels, although it retards the process, does not offer an insurmountable obstacle to successful hydraulicking.

ARE NEW GOLD DISTRICTS LIKELY TO BE FOUND?

Shall we ever find another gold district like the Klondike? This question has often been asked since the returns from the latter have diminished so greatly. The probabilities are in favour of discovering other very productive gold districts in British Columbia, the Yukon territory, and the western and northern parts of the North-west territories. These great regions are, as yet, only very imperfectly explored. The rocks of the Klondike are probably repeated in some districts within the great regions just enumerated. The geological conditions of this district are sufficiently known to enable prospectors to recognise similar conditions if found elsewhere. The Tanana River, in Eastern Alaska, is a case in point. This stream flows parallel to the Upper Yukon, at about 120 miles west of it, and joins the Lower Yukon 200 miles below Porcupine River. Since 1904 its valley has been producing almost as much gold as the Klondike district. Mr. Joseph Keele, of the Geological Survey, who for the last few years has been investigating the Stewart River region, has found workable placers in several localities, and these may be only forerunners of richer ones which will be found in the same district. Discoveries of heavy placer gold have been lately reported on Dease River, which joins the Frances, to form the Liard, in latitude 60 degrees and longitude 128 degrees 30 minutes W. The writer has heard of discoveries of coarse gold in this region on two former occasions within the last twenty-five years. The placers of Cassiar district, which about twenty years ago were yielding the greater part of the gold then produced in British Columbia, are situated not far from Dease River. Possibly other goldfields may be discovered in the territory lying southward of Herschel Island, perhaps about 100 miles inland.

THE NET RESULT.

The large quantity of gold from the Klondike which has been added to the world's supply may be of some service to mankind in general, but it is doubtful if the total removal of this virgin wealth out of the country has been any gain to Canada. The greater part of it went to the Pacific seaboard of the United States, and helped materially to build up such cities as Spokane, Portland, and Seattle. Very little of it remained in Canada. No permanent development worth much—no equivalent in any form—was left to pay for even a portion of the immense amount of gold taken out of the country. It would be better for Canada at this moment if the Klondike had remained undiscovered until we were in a position to secure the gold for ourselves. A greater sum than the amount of the royalties paid by those who were enriching themselves was spent in providing facilities, such as roads and bridges, for getting out and removing the gold, and this was also a direct loss to Canada. As soon as the pay streak along the bed of a creek was exhausted, the miners all abandoned their flimsy buildings, framework for machinery, flumes, pumps, sluices, and all kinds of appliances or apparatus, their rude furniture, and even their cheap bedding and old clothes. The next flood overturned and mixed up all these evidences of temporary habitation, and left only wreckage along the bottoms of the valleys—a sad spectacle, as if the tide had gone out and exposed the ruins of our richest goldfield.

Besides the actual gold taken away, the country is said to be "out" a large sum on account of such expenditure as large salaries to overpaid officials, cost of public buildings, courthouse, schools, governor's residence, post office, police barracks, also a park—all in Dawson town, to say nothing of frauds in making payments everywhere; so that the final result of the mining and all transactions connected therewith has been a serious deficit, apart from the loss of the gold itself.